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Avinash Gugal

Department of Horticulture,
Lovely Professional University,
Phagwara, Punjab, India

Amit Kotiyal

Department of Horticulture,
Lovely Professional University,
Phagwara, Punjab, India

A review on current status and challenges in cultivation of underutilised fruits crops of India

Avinash Gugal and Amit Kotiyal

Abstract

This review describes the crops, which are lesser-known plant species in terms of marketing and research, but well adapted to marginal and stress conditions. Their indigenous potential and ethnobotanical data are well known to people, whereas, commercial importance and market value is unknown to the public. These are neither grown commercially on large scale nor traded widely, but utilised in daily life. From the ongoing researches worldwide, it is evident that underutilised edible plants possess high nutritional value. These plant species were good source of vitamins and minerals, but have now become less important. Due to lack of producer interest and yield majority of these species have come near extinction. There is need to increase the importance and knowledge in order to maintain cultural traditions and facilitate research into food history and new food sources. The Indian Government policies and International centres are supporting these crops by spreading the awareness and significance about the underutilised crops which may lead to gradual increase in Indian economy, food security, nutrition, dietary and culinary diversification, health and income generation. So, through this review paper we can understand current status, constraints and these crops can be treasures of future India and have more potential for food security, income generation, increases agriculture crop diversity and environmental services.

Keywords: Underutilized fruits, current status, problems and strategies

Introduction

India stands in a prominent position on the pomological map of the world. The variation in weather and climatic conditions of the country which provide suitable environment for growing of different variety of fruits. These fruits available in abundance which resulted in limited scope for expansion of other minor fruit crops, even though they are rich nutrients, vitamins and minerals. These minor crops are also named as underutilised crops which are main source of livelihood for the poor (T.M. Gajanana *et al.* 2010). Underutilised crops are lesser-known plant species in terms of marketing and research, but well adapted to marginal and stress conditions. The underutilised fruits can also be defined as the fruits which are less available, less utilized or rarely and used in specific region. The regions like semi- arid, we find the oldest fruit trees crops with wide distribution and their adaptation to a wide range of soil and climatic conditions of our country (Sharath Chandra *et al.*, 2020). According to Indian theory of existence "Everything on the earth has a purpose, every disease an herb to cure it, and every person a mission" (Dove and Salish, 2010). In human history, 40-1,00,000 plant species have been regularly used for food, fibres, industrial, cultural and medicinal purposes. Among these 7,000 cultivated species are in use around the world (Simrandeep Kour *et al.*, 2018)^[18] (Magbagbeola *et al.*, 2010). On the basis of the world's agriculture, over the last five hundred years, with increased populations and development of a global trading system, around 30 crop species have become more cultivated and widely consumed. These commodity crops have been the focus of attention of markets and scientific research world-wide. The fate of the vast majority of the remaining agro-biodiversity has been quite different: some species have been replaced or fallen into disuse, while others have remained important in their centres of origin or secondary centres of diversity, but largely ignored by commerce and science (Stefano Padulos *et al.*).

In 2017, the undernourished people increase to 821 million, signalling a rise in world hunger and a reversal of trends following a prolonged decline (FAO, IFAD, UNICEF, EFP, WHO 2017-20). Child stunting which is not acceptable i.e. it has increased approximately to 151 million. About 2 billion people lack main micronutrients which are need for physical and mental development such as iron and Vitamin A (Development initiatives 2017).

Corresponding Author:

Avinash Gugal

Department of Horticulture,
Lovely Professional University,
Phagwara, Punjab, India

Particularly in emerging economies and in low-to-middle income countries (Forouzanfar *et al.*, 2015); In order to help a diverse and healthy diet and to combat micronutrient and deficiencies, the so called 'Hidden hunger', we have to concentrate on every plant and plant part have its own utility; unless we realise the value of that product they are underutilised (Francesco Burchi *et al.*, 2013). Many neglected and underutilized species are nutritionally rich and adapted to low input agriculture. The erosion of these species can have immediate consequences on the nutritional status and food security of the poor (Dansi *et al.*, 2012). Through this review paper an attempt was made to identify various underutilised fruits, their potential to prepare various products and know the current status of underutilised fruits. demand and marketing of such products and process of preparation into various products.

Major concern about Underutilised fruit

1. Crops must have specific character and useful for human activities.
2. Crops should be not being widely distributed; it should be native to confined region.
3. These crops should not be cultivated in large manner compared to regular crops.
4. Crops, which given less attention from research, farmers and other official persons.
5. It may be having high nutritious, therapeutic properties and other medicinal uses.
6. These crops should increase agricultural production and enhance crop diversification.

Underutilised crops seen in India

There are many underutilised fruit crops, which are not well known or cultivated in India. Some of the underutilised fruit species are as follows:

Aonla/Amalaki/Amla (*Emblica officinalis*)

Aonla (*Emblica officinalis*) or Indian gooseberry is indigenous to Indian sub-continent. India ranks first in the world in area and production of this crop (NHB, 20019-20). It is a deciduous fruiting plant and second richest natural source of vitamin C (ascorbic acid) having approximately 600 to 700 mg per fruit which makes its wide use in Ayurveda medicine (Rajpreet Kaur *et al.*, 2015). Useful for haemorrhage, leucorrhoea (Hasan, 2010) and reduces blood sugar in diabetic patient (Iyer *et al.*, 2009). To prevent non-enzymatic browning and retains better colour, blanching is carried (Gauri Athawale and Akbari Sanjay., 2020) [2]. Cleft grafting on 5-6 months old aonla by capping method show high success rate of 87% and Capping of grafts at day 21 showed the maximum success (87%), followed by that at 23 and 25 days (R. K. Tiwari *et al.*, 2002). Patch budding being commercially followed for propagation and NA-7 is promising variety for arid zones (A.K. Singh *et al.*, 2020). Krishna variety have shelf life of 10 days and NA-7 can retain up-to 6-8 days in north Indian conditions. (Singh *et al.*, 2019).

Ber/Indian Jujube (*Zyziphus mauritiana*)

It belongs to the family Rhamnaceae an ideal fruit tree for arid and semi-arid regions in tropical and subtropical climate. Fruits are greenish yellow to reddish brown. It has a high amount of vitamin C (85-95 mg per 100 g) (Anonymous, 2021. Ber cultivation. Access date 29/09/2021

<https://tnauagriportal>). These fruits are used for making several products like chutney, dried ber, murabba, jelly, etc. Short shelf life, postharvest rotting, and chilling injury are the most important problems. (Pareek *et al.*, 2013) [14]. The powder of ber roots has medicinal properties for curing ulcer, fever and wounds. (Simrandeep Kour *et al.*, 2018) [18]. It contains active ingredients that have antimicrobial effects of ethanolic against *Escherichia*, *Staphylococcus* and *Candida* microorganisms. (Upadhyay S *et al.*, 2012) [19]. Jujube powder can be stored for a long-time and used in many food formulations. Besides, SMIR, MVFD, MVP, and VFD are usually employed as drying methods for producing good quality of dried jujube (jujube powder). (K Ahmed *et al.*, 2020). When it comes for propagation, the 'Gola' variety that is multiplied by an *in vitro* micro grafting an exotic species. (Anonymous, 2021. Ber cultivation. Access date 29/09/2021 <https://tnauagriportal.in>).

Fig (*Ficus carica*)

Fig was an important food crop since ancient civilization. It is a highly nutritious fruit consisting of 84% pulp and 16% skin. Besides, the fruit also contains protein, calcium, iron, vitamin A and thiamine at varying concentrations. Zinc oxide nanoparticles were synthesized first time using fig leaf extract. SEM images revealed formation of ZnO nanoparticles demonstrated high bactericidal activity of 17 mm against *E. coli* and *K. pneumoniae*. In vitro tetraploidization in two fig cultivars, namely 'Sabz' and 'Torsh', was successfully established using shoot tip explants and colchicine as the antimetabolic agent in MS medium. (Ruhollah A *et al.*, 2021) [16].

Karonda (*Carissa carandas*)

It is a hardy, evergreen, spiny and indigenous shrub, which thrives well as rainfed crop. The fruit belongs to the family Apocynaceae. Fruits, sour and astringent in taste, are a very rich in iron contains a good amount of Vitamin C. Phytochemicals such as alkaloids, saponins, flavonoids, phenols, terpenoid, glycosides and carbohydrates. It consists microelements level such as chromium, copper, ferrous, manganese, nickel, selenium, sulphur, and zinc were measured. (Thiyagarajan *et al.*, 2020).

Passion fruit (*Passiflora edulis*)

It is native to tropical America. It produces fruits with unique flavour and aroma for fresh eating and processing as well. Passion fruits are good source of Vitamin A, Ascorbic acid, Riboflavin and Niacin and have a high mineral content. (Simrandeep Kour *et al.*, 2018) [18]. *P. indica* influences the growth and immunity of passion fruit plants throughout the plant life. Salicylic acid accumulation and SA-related defensive responses are higher in colonized plants. Metabolite profile analysis shows that *P. indica* can improve the fruit quality. (Yan C. *et al.*, 2021).

Pummelo/Jambura (*Citrus grandis*): It is the largest citrus fruit and belongs to the family Rutaceae. It is also known as "Shaddock" and locally called "Jambura". It is a mono embryonic species which is native to Malaysia and Polynesia. Fruits are sweet and moderately juicy. Two types, *viz.* white fleshed and red or pink fleshed are available in India and cultivars are named accordingly. The fruits are eaten fresh or processed into juice. Pummelo fruit is also an excellent source of vitamin A, B and C. (Diengngan S, Hasan, 2015).

Dragon fruit

Dragon fruit belongs to family Cactaceae, is a perennial semi epiphytic vine. It was initially used as ornamental plant and latter due to its health benefits and market value emerged as a new fruit crop. It requires less water for growth and development due to its CAM pathway. Thus, it could be a lucrative fruit crop, particularly for degraded lands, abiotic stress and rainfed areas of the country. (Kakade V. 2020) [11]. In India, Single pole with cement and iron ring, continuous pyramid stands and 'T' stands trellis systems were tested for dragon fruit at ICAR-IIHR, Bangalore (Karnataka), but Single pole with a cement ring was reported better. The anthracnose, fruit and stem rot, stem canker and the cactus viral disease are among the most frequently reported diseases of dragon fruit. (Balendres M.A., 2019) [13].

Starfruit (*Averrhoa carambola* L)

Star fruit is a small to medium sized, juicy tropical exotic fruit and native to Indonesia, Malaysia and southern China. Due to presence of oxalic acid, it is acidic in nature. Different names in India for Carambola, Star fruit (English), Kamrakh (Hindi and Gujarati), Kamranga (Bengali), Karambal (Marathi and Konkani), Karambal-drakshi, Kaparakshi hannu (Kannada), Chaturappuli, Vairappuli (Malayalam), Karmanga (Oriya), Thambaratham (Tamil), Ambanamkaya (Telugu), Kordoi, Rohdoi (Assamese). (Anonymous, 2021. Star fruit cultivation. Access date 06/10/2021 <https://agrifarming.in>). To increase shelf life chemicals were used. Putrescine maintained quality and suppressed cell wall metabolism of carambola. Putrescine and spermidine improved phenolic and antioxidants capacity. Spermidine enhanced ascorbic acid level. (Azhane A. & Asgar A., 2019) [3].

Jackfruit (*Artocarpus heterophyllus*)

Jackfruit (*Artocarpus heterophyllus* Lam) largest tree born tropical fruit in the world belongs to the family Moraceae. It is a monoecious evergreen tree, indigenous to the rain forests of the Western Ghats in the south-western parts of India (Baliga *et al.*, 2011). Lead bio sorption using Jackfruit and Jamun biosorbents. The maximum adsorption capacity of Jackfruit was 4.93 mg/g. Optimum Lead removal was about 96% using jackfruit as bio-adsorbent. The kinetic studies well explained in terms of Temkin and Elovich model, respectively. (Deen Dayal G. *et al.*, 2021).

Current research status of underutilised fruit crops

The past three decades have seen a wide and varied range of research interests on underutilised crops. Whereas most of these interests were focused on particular projects of individual researchers, there have been a number of significant programmes to promote underutilised species for agricultural systems, as alternative crops or as sources of new products; and these programmes have been undertaken in both developing and developed countries. Additionally, there has been a broader recognition that underutilised crops should always be promoted, to improve food security. A report on current research and research proposals for enhanced cooperation on UUC 's was documented by Williams and Haq (2002). Various international research organizations have been established to focus on UUC 's which have been enlisted:

International Centre for Underutilised Crops (ICUC)

This is a research, development and training organization. It provides expertise and acts as a knowledge hub and supported research on national priorities for germplasm collections, agronomy and post-harvest methodology of underutilised species and associated conferences and training events. In recent years, the focus has expanded to include processing and marketing assessments and entrepreneurship development only. ICUC have several professional networks in twenty-one countries in particular as UTFANET (Underutilised Tropical Fruits in Asia Network), UTVAPNET (Underutilised Tropical Vegetables for Asia and the Pacific Network), SEANUC (Southern and East Africa Network for Underutilised Crops and ACUC (Asian Centre for Underutilised Crops) etc. (Monika Thakur. 2014).

Global facilitation unit (GFU)

The GFU is a multi-institutional initiative that acts globally to promote a wider use of underutilised plant species through supporting and facilitating the work of other stakeholders. The mission rather to create an enabling environment for stakeholders who are engaged in developing underutilised species. (Thakur M., 2014).

Convention on biological diversity (CBD)

Became a rallying point and promoted the concept of maintaining local agrobiodiversity. All these various international units, which are working on underutilised species, have led to a better liaison between relatively isolated groups of workers but there are still major gaps. The Consultative Group on International Agricultural Research (CGIAR) organized a workshop in 1999 at Chennai (India) followed the major FAO Global Plan of Action. One of the outcomes was a recommendation to survey all ongoing activities on underutilised species worldwide.

The mission rather to create an enabling environment for stakeholders who are engaged in developing underutilised species [Facilitation Unit (GFU) for Underutilised Species]. In addition, crops for the Future Research Centre (CFFRC), a research arm of CFF being built adjacent to UNMC is the first-of-its kind, with a global mandate for research and development of underutilised plants for food and non-food uses.

Crops for the Future (CFF)

An independent, international organization works with its partners and has a mandate to promote and facilitate the greater use of neglected and underutilised crops to advocate research, policies, and capacity building on underutilised crops for the diversification of agricultural systems and diets (Crops for the Future, 2009-13). It was formed in 2008 following a merger between the International Centre for Underutilised Crops (ICUC) and the Global Facilitation Unit (GFU) for Underutilised Species. In addition, Crops for the Future Research Centre (CFFRC), a research arm of CFF being built adjacent to UNMC is the first-of-its kind, with a global mandate for research and development of underutilised plants for food and non-food uses. (Monika Thakur., 2014).

Indian government strategy

In India, strategy development and appropriate policies are

limited to a large extent by a lack of authentic documentation on underutilized crops. The Indian government policies and strategies for food security should take into account the diversity of underutilized crops. For this thing the Ethnobotanical data available on indigenous, neglected Indian crops is more valuable. Indigenous knowledge must be tapped and combined from various localities and merged with scientific solutions to create new opportunities. Recognition of UUC's in India was initiated in 1960's at the Indian Agricultural Research Institute, New Delhi. This research was later extended by, All India Coordinated Research Project (AICRP) on Under-utilized plants (UUP) in 1982, with its headquarters at National Bureau of Plant Genetic Resources (NBPGR), New Delhi, towards, collection, evaluation, utilization and conservation/ maintenance of underutilized crops.

Later on, this work was also carried out in various parts of India (Paroda, 1979; Bhag Mal, 1988; Bhag Mal and Joshi, 1991; Paroda and Bhag Mal, 1989, 1992; Joshi *et al.*, 2002; Joshi, 2005). So far, 115 leafy vegetables and 46 other vegetables have been documented as underutilized in India (Anonymous, 2003). Ravi *et al.*, (2010) discussed the mobilizing neglected and underutilized crops to strengthen food security and alleviate poverty in India. In India, also a national co-ordinated project by Ministry of Agriculture has been launched to do research on UUC's. Still the threat has been for the crops as their underutilized potential is continued to be underutilized, ultimately this will lead to disappearance of the same crop.

Importance of Underutilised Crops

1. Underutilised have different and special features in them. They are the integral part of the local culture and used for traditional food and culinary preparations.
2. These crops are adaptable for different climatic zones and changes in weather conditions.
3. Crops are able to withstand biotic and abiotic stressful conditions.
4. Underutilised crops are cultivated by using low inputs and not using any different biological techniques.
5. Rich in Vitamins, Minerals and have Medicinal properties and can be grown in wasteland without much care.
6. These crops have much value in post-harvest products like pickles, jam and jellies.
7. Underutilised crops have the potential to make a substantial contribution to food and nutrition security, to protect against internal and external market disruptions and climate uncertainties, and lead to better ecosystem functions and services which enhances sustainability (Keatinge *et al.*, 2010).
8. It reduces the risk of over-dependency on very limited numbers of major staple food crops.
9. Usage of marginal and wastelands for agricultural purposes to meet the ever increasing food demand (Mayes *et al.*, 2011).

Limitations in Utilization Underutilised crops

1. No knowledge and information on production, nutritional quality, consumption and utilization of many of the underutilized plant products which are unpopular compared to major fruits.
2. Awareness on economic benefits and market

opportunities is deficient.

3. Default technology for value addition through village level food processing.
4. No proper improved quality planting material and not using any biotechnology or breeding activities to reduce the gestation period and enhance the fruit production.
5. Showing less interest by researchers, agriculturists and extension workers.
6. Lack of producer interest and low yield.
7. Post-harvest and transport losses.
8. Non-existence of marketing network and infrastructure facility for underutilized fruits.
9. There is no proper national policy and credit and investment.
10. Shortage of scientific resources for testing, valuation and post-harvest management of different underutilized fruits.

Various processed products from underutilised fruits

The main processed products consumed by people were jam, RTS – fruit drinks, chutneys, candies, pickles, squashes, concentrate etc. (Roy, 2000; Khurdiya, 2001; Singh *et al.*, 2008). Various processed products such as nectar, squash, slab, toffee powder, etc. can be made with Beal pulp. Ber can be processed to prepared murrabba, candy, dehydrated ber, pulp, jam, and ready-to serve beverage (Khurdiya, 1980; Pareek, 2001). Jamun fruits can be processed into excellent quality fermented and non-fermented beverages. (Monika Thakur, 2014).

Conclusion

Underutilized crops were once cultivated in vast area but today gradually decreasing in area and production. This may lead to decrease of agronomic, genetic, economic and cultural factors. These crop are less concentrated by the farmers and consumers because as they are not prominent as other cultivated crop species in the same agricultural environment. The general decline of these crops may erode the genetic base and prevent the use of distinctive useful traits in crop adaptation and improvement. Adaptation of new fruit sources will bring the unexploited underutilized and neglected plants into mainstream of consumption. To overcome these problems, the development of technologies is required urgently to minimize the losses during post-harvest handling and also technologies suitable for specific processing purposes, products development and storage of fresh and processed products.

However, this paper will attempt to provide the background, policies, international centres, current research, constraints for sustainable production, approaches to research and potential strategies and action plans which we hope would be helpful to lead the strategic development of underutilized crops for sustainable food and nutrition security and poverty alleviation. It finally concludes that importance and uses of the underutilized crops in India, the potential for agricultural - rural development and food and nutrition deficiency can be minimized.

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